

University of Washington Husky Stadium

Report Number: 93908 / 5258 Report Status: Final Client: AstroTurf 2680 Abutment Road SE Dalton, Georgia 30721



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Project Name	University of Washington – Husky Stadium	Test Date	07/15/2023
Client Information	AstroTurf		
Site Address	3800 Montlake Bvd NE, Seattle, WA 98195		
Report Status	Final		
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Introduction

On-Site field performance testing was carried out at the University of Washington – Husky Stadium - Alaska Airlines Field in accordance with EN and ASTM test methods cited within standards set by the One Turf Concept.

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Test Methods

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•	Shock Absorption	EN 16717:2014
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- Vertical Deformation EN 16717:2014
- Energy Restitution EN 16717:2014
- Rotational Resistance EN 15301:2007
- Ball Rebound EN 12235:2013
 - Ball Roll
- HIC Critical Fall Height EN 1177:2018
- Gmax Impact Attenuation ASTM F1936-19
- Surface Planarity EN 7370-2003

Foreword

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EN 12234:2013



1.0 – Results Summary

Property	Limits	Mean								Res	ults	Scale			N	lin l	∕lean ♦	Max —	
Force Reduction	55 – 70 (%)	66	42	44	46	48	50	52	54 56	58	60	62	6 4	6 6	68	70	72	74 76	78
Vertical Deformation	5.5 – 11.0 (mm)	8.8	3.0	3.5	4.0	4.5	5.0 !	5.5 6.	0 6.5	7.0	7.5	8.0	8.5	9.0	 9.5 :	10.0 1	0.5 11.	0 11.5	12.0
Energy Restitution	20 – 50 (%)	41	12	15	18	21	24	27	30	33	36	• 39	♦ 42	45	48	51	54	57	60
Rotational Resistance	30 – 45 (Nm)	33	20	22	24	26	i 28	• 30	32	♦ ● 34	36	38	40	42	44	4 4E	48	50	52
Ball Rebound	0.60 – 1.00 (m)	0.86	40	45	50	55	60	65	70	75	80	● ◆ 85	90	95	100) 105	110	115	120
Ball Roll	4.0 – 10.0 (m)	8.8	3	4	5	6	7	8	••• 9	10	11	12	13	14	- 1	5 16	i 17	18	19
ніс	≥ 1.3m	1.84	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	• • 3 1.9	2.0	2.1	2.2
Gmax	>200 (gs)	94	60	70	80	90	••• 100	110	120	130	140	150	160	170	180	190	200	210	220
Planarity	None >10 mm	N/A	See I	Diagr	am														

2.0 – Field Information & Test Conditions

Syster	n Details	Testin	g Conditions	
Carpet Product	Rootzone 3D3 Blend		am	pm
		Air Temp. (F)	72	74
Performance Infill	Green Coated SBR	Surface Temp. (F)	88	105
Stabilizing Infill	Sand	Humidity (%)	58	53
Test Condition	Dry	Weather Conditions	Clear,	Sunny
Underlayment	Brock Powerbase Pro	Wind Speed (m/s)	0.	02
Substrate Type	Dynamic Stone	Operator	N	ік



3.0 – <u>Test Results</u>

3.1 - Advanced Artificial Athlete Test Results

Property											Test	Loca	tion											
rioperty	Limits	Α	В	с	D	E	F	G	н	I	J	к	L	м	N	ο	Р	Q	R	S	R1	R2	R3	R4
Shock Absorption	55-70	66	66	67	66	64	68	68	66	67	65	67	65	64	65	68	66	66	65	64	65	67	67	63
(%)	Consistency +/-10%	0.7	0.2	-1.4	-0.1	2.3	-3.3	-3.1	0.3	-1.8	1.7	-0.9	0.8	2.6	1.5	-3.4	-0.8	-0.3	1.5	3.0	0.9	-1.9	-1.7	4.0
Vertical Deformation	5.5-11.0	9.2	8.9	9.2	8.6	8.3	9.6	9.3	8.7	8.8	8.5	8.9	8.6	8.3	8.6	9.5	9.1	8.8	8.4	8.6	8.8	9.1	9.0	8.6
(mm)	Consistency +/-15%	0.4	0.1	0.4	-0.2	-0.5	0.7	0.5	-0.1	-0.1	-0.4	0.0	-0.2	-0.5	-0.2	0.6	0.3	-0.1	-0.4	-0.2	-0.1	0.2	0.1	-0.2
Energy Restitution	20-50	41	42	39	40	42	39	40	42	41	42	42	41	40	41	40	41	42	42	42	43	39	39	41
(%)	Consistency	0	-3	4	2	-4	4	2	-2	0	-2	-3	-1	2	-1	1	0	-2	-1	-2	-4	6	6	-1
Infill Depth (mm)	Info Only	28	31	30	28	32	30	26	28	27	28	32	30	29	32	32	32	31	32	30	29	26	30	28
Free Pile (mm)	Info Only	7	10	11	15	11	10	16	15	12	10	10	11	11	12	10	10	10	11	10	8	18	15	10
																					_			
	, in the second s		Goal		10	20		30	40		R1)0	40)	30	2	0	10		Goal					





3.2 - Rotational Resistance, Ball Rebound, Ball Roll Test Results

Duouseutus	Lingite					Test Po	osition				
Property	Limits	1	2	3	4	5	6	R1	R2	R3	R4
Rotational	25 – 50 Uncertainty: +/- 2 Nm	34	32	29	34	34	31	34	33	32	33
Resistance (Nm)	Consistency (+/- 10%)	-1	0	4	-1	-1	1	-1	0	0	-1
Ball Rebound (m)	0.60 – 1.00 Uncertainty: +/- 0.03 m	0.84	0.90	0.87	0.85	0.90	0.88	0.84	0.86	0.85	0.84
	Consistency (+/- 10%)	3	-4	-1	2	-4	-2	3	1	1	2
Ball Roll (m)	4.0 – 10.0 Uncertainty: +/- 0.05 m	8.8	9.0	8.7	8.5	8.9	8.7				
	Consistency (+/- 15%)	-1	-2	1	3	-1	0				
HIC (m)	≥1.3m	1.87	1.90	1.85	1.81	1.80	1.83				
	Goal 10	20 	30 		• 40 • 100 000 000 000 000 000 000 000 000 00	30 	20 	10 	Goal	R2	



3.3 - Planarity Test Results



3.4 – Gmax Test Results

*Note: Full test report in separate document





4.0 - Site Overview Photos



5.0 - Discussion & Conclusions

Property	*Limits	Mean			Pe	rforn	nanc	e Tes	st Re	sults	Scal	le Su	mma	iry		Mi	in	Mean	M	ax)	
Shock Absorption	55 – 70 (%)	66	42	44	46	48	50	52	54	56	58	60	62	64	6 6	• 68	70	72	74	76	78
Definition: Sho absorption mea	ock Absorption ans a firmer su	percentage is rface. Ideally, t	a mea he sur	asure face i	of fii s bot	rmne h shc	ss of ock al	the osort	field bent,	as ex yet s	operio uppo	enceo ortive	d by ly fir	the a m.	thlet	e unc	ler fo	oot. A	\ lov	ver	shock
Conclusion: Sh optimal for ath	lock Absorptic Iletic activity f	on results dem for the athlete	onstra	ate th	nat th	ie su	rface	prov	vides	suita	able	cush	ionir	ıg wh	ile p	rovid	ling a	i leve	el of	firn	nness

Deformation (mm) 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0	Vertical	4.0-11.0	8.8)	♦						
	Deformation	(mm)	U.C	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0

Definition: Vertical deformation is the depth that the player's foot would depress into the surface during movement. A surface that is soft, or "spongy" will not provide the stability required of athlete performance and could stress lower extremity muscles. A surface with too little elasticity could result in higher impact and energy transfer into lower extremities.

Conclusion: The vertical deformation results indicate the field offers support underfoot with minimal surface depression during contact.



Energy Restitution	20 – 50 (%)	41	12	15	18	21	24	27	30	33	36	• 39	◆ ● 42	45	48	51	54	57	60
Definition: En while a softer s restitution valu	ergy Restitutio surface will req ue indicates mc	n is a measure uire more worl pre energy tran	of ene k for th	ergy ro e ath ce.	eturn lete to	ed to o pusl	the a h off f	thlete rom t	e. A fi he su	rmer Irface	surfa , whic	ce wil :h can	ll tran I cont	smit ribute	more e to fa	ener§ atigue	gy to . A hi	the a gher e	thlete, energy

Conclusion: Locations tested are shown to be within optimal range to mitigate additional energy expended by the athlete while pushing off the surface.

Ball Roll	4.0 - 12.0	8.8							+0										
builtion	(m)	0.0	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Definition: Bal with the field d to simulate nat measurements.	l Roll is the dist uring game pla ural grass as ir	ance a ball will y. The test is a Itended. Poor 1	roll acı Iso a go fiber co	ross t ood ir onditi	he sur ndicat on an	face. or of d flat	The p fiber o fibers	urpos condit s will a	e of t ion, a alter (his te as ver game	st is to tical f -play,	o conf ibers as in	firm th will p dicate	ne cor rovide ed by l	nsister e adeo less th	ncy of quate nan de	⁻ ball i fricti esirat	ntera on ne ole ba	ction eded II roll
Constructions Do		- l i l i																	

<u>Conclusion</u>: Ball roll results show that most of surface provides adequate ball and surface interaction characteristics. Fibers are in good, semi-vertical condition.

Ball Rebound	0.60 – 1.0 (m)	0.86	40	45	50	55	60	65	70	75	80	●◆ 85	9 0	95	100	105	110	115	120
<u>Definition:</u> The with respect to	e height at wh 5 ball interacti	ich a ball will i on within the	ebour playin	d off g fiel	the s d.	surfac	e shc	ould b	e wit	hin a	rang	e as a	mea	sure	of co	nsiste	ency a	nd co	ontrol
Conclusion: Ba rebound is abr	all rebound ch normally low a	aracteristics a and conversely	re witl , overl	nin o y cor	ptima npac	l ran ted a	ge. Tl reas v	ne co which	nsiste can i	ency o increa	of the ase re	e surfa ebour	ace w 1d.	'ill mi	itigat	e 'dea	nd zor	nes' v	vhere



Rotational Resistance	25 – 50 (Nm)	33	20	22	24	26	28	• 30	32	♦ ● 34	36	38	40	42	44	46	48	50	52
Definition: Rot contact with th athlete and the This can also pr	tational Resista ne surface. A lo surface. Resul resent higher r	ance, or Tractio ow rotational r ts that are too isk to potentia	n Testi esistar high or I lower	ng, is t ice res low d leg ar	the m sult su emor nd kne	easur ugges Istrati ee inju	e of h ts les: e pote uries v	iow w s trac ential where	ell a c tion, v limits slipp	leate while to th ing o	d foot a hig e play r lack	t plan h res vers al of fre	ted in ult ind bility i e mo	the t dicate in ma bility	urf wi es exc intain can o	ill mai ess gi iing el iccur.	intain rip be ffectiv	contr etwee ve tra	rolled n the ction.
Conclusion: Re running, cuttir	esults demons ng and intense	strate that the activity.	e surfa	ce is (effect	ive a	llowii	ng us	ers to	o mai	ntain	cont	rollec	d con	tact	with †	the fi	eld d	uring

HIC	≥ 1.3m	1.84	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1 .9	2.0	2.1	2.2
Definition: Head Injury Criterion (HIC) testing measures shock attenuation, or the ability for the surface to absorb an impact as related to direct head to surface impacts. HIC testing has been adapted for sports surfaces on which high impact sports are played. The fall height at which serious injury can potentially occur as a result of a head impact is referred to as the Critical Fall Height (CFH).																			
<u>Conclusion</u> : Critical Fall Height was calculated to be well above the industry recommended standard of 1.3 meters. The surface is exceedingly effective in mitigating risk of injury in the event of direct head-to-surface contact.																			

Gmax	<200 (Gs)	94	60	70	80	●- 90	•• 100	110	120	130	140	150	160	170	180	190	200	210	220
Definition: The Gmax test is the most commonly used method of measuring surface shock attenuation in the United States. A value of 200 is the limit to which risk of impact injury increases significantly. The Gmax test is primarily used for determination of overall safety with respect to direct impact between athlete and the playing field.																			
<u>Conclusion</u> : The surface is in compliance for shock attenuation properties prescribed by ASTM F1936-19.																			

End of Report